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Production Management

SYSTEMS AND SYNTHESIS

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*To Christopher and Loren Starr —
with love*

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Preface

The spirit of this book is embodied in the relationship of systems analysis to systems synthesis. The distinction between analysis and synthesis is neither esoteric nor academic. Analytic behavior follows what might be called *principles of disassembly*. It exists in terms of operations that involve division, dissection, classification, separation, partitioning, segmentation, and so forth. Thus, using analysis we proceed to take the production management domain apart. We study the pieces and attempt to improve them. Then we reassemble the system, but because of interactions and dependencies between the parts it is quite possible that the reassembled production function will not be improved and may be impaired.

Synthesis is required to put things back together again in a measurably *satisfactory* way. To achieve this objective, it may be necessary to modify the results derived by analysis of isolated parts. Synthesizing behavior can be expressed as a set of (corollary) *principles of assembly*, involving operations of summation, integration, unification, combination, amalgamation, and in general, the gestalt point of view.

Although analysis requires much patience and perseverance with detail, great analytic accomplishments are frequently associated with sudden insights and with the Eureka (I've got it) phenomenon. Synthesis must involve the various aptitudes associated with analysis, being, itself, a meta-form of analysis. In addition, it can be identified with attitudes and activities that are

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common to architecture, art, and sculpture. Here, creativity thrives on overview abilities that take advantage of penetrating insights.

Because analysis is not constrained with respect to the minimum size of the system's-grouping to be studied, and because synthesis is usually so constrained, it is not surprising that analysis is commonplace in the production management field whereas synthesis is not. In recent years, analytical developments occurred at such a great rate that the decision of how to use these results has been treated as though it were a matter of personal choice. For this relatively rational world, guided by enterprise objectives of survival, profit, and growth, that conclusion can hardly be justified. Yet, for a while now, it has seemed that the only acceptable question which could be raised was: How important are analytical and mathematical tools for *proper management* of the production function?

One school of thought said—"not very important". Consequent to this point of view, techniques of methodology could be virtually ignored or relegated to the solution of problems in isolation. Such an approach violates the essence of the principle of synthesis. At the opposite extreme was the belief that fully evolved mathematical models represent the highest form of management rationality and, by implication, that managers were obsoleted and superseded within these specialized areas. It will be recognized that both attitudes foster compartmentalization and are destructive of the total systems point of view. Most production managers, however, expressed opinions which held, in effect, that the importance of analytical developments could be assessed only after a reasonable level of synthesis was accomplished. The question that really needed to be answered was: How can a reasonable degree of synthesis be achieved?

The content and contexture of this book have been developed with the intention of providing the required systems-oriented view of the production management field. Toward this end, the executive must understand thoroughly what analytic tools are available and how he can relate them to the total system with which he must deal. But, before such knowledge could be conveyed it was necessary to develop a comprehensive analog to represent the production function and its management. The task has been accomplished, at least partially, by means of an input-(process)-output model. The structure of this model underlies the entire book.

In this way, production management has been defined in the most general terms so that it encompasses all transformation procedures which fit the input-output construct. Thus, industries engaged in manufacturing, transportation, communication, and those utilizing extractive processes or providing service functions can be included. The total system is recognized as being composed of a variety of processes that are the results of one or more operations which are then, in turn, composed of some set of fundamental elements—common to all operations. Elements of (physical) works are entirely familiar to production managers in this context. The same cannot be said about decision elements, yet without an understanding of these latter elements it is unwise to hope for even a modicum of success in achieving synthesis. Consequently, the decision-theory framework is explained at length and then maintained throughout the book.

But the structure would still be incomplete without due attention being paid to behavioral elements and the interrelations of men, machines, and facilities. On the one hand, it is essential to recognize the physiological, psychological, psychiatric, and sociological factors that can help to explain the behaviors of the human components

of the system. These include consumers, workers, stockholders, competitors, suppliers, and managers. Under other circumstances these individuals can be adequately represented as probabilistic elements in a quasi-deterministic system.

Because the goal of synthesis involves the production manager with his total system, still other issues must be considered. These include:

1. The interrelations of the traditional organizational areas, that is, the interacting roles of finance, marketing, and production. To convey the resultant perspectives in their fullest sense, the Appendix of this book presents two outstanding essays written by specialists in these two boundary fields. In turn, finance and marketing are considered from the viewpoint of the production manager throughout the text. The areas of consensus or divergence are somewhat subtle, but exciting.

2. Interactions of the internal system with the external world. These include the effects of competition on the production management function as well as legal, institutional, and governmental restraints; economic effects—both national and international; vendor relations; community and union attitudes; and social system factors in general.

3. Differentiation between:

- (a) The design of the production system with respect to products, processes, facilities, and so forth.
- (b) The planning required for actualization of the production system design. (A PERT format is used as an integral part of the book's organization and structure.)
- (c) The design of requisite control systems operating at various levels of involvement with computers, automation, and the concept of management by exception.

4. The interactions of methodology, technology, and administration in the production management field, and how such distinctions are encountered in designing the system or controlling its use.

5. The differentiation between long- and short-term planning; also between repetitive and nonrepetitive decision systems. Both of these distinctions gain their fundamental significance only when the search for synthesis is invoked.

This book has been written to serve as an introductory text. In other words, no prior knowledge of the field is assumed and only a minimum ability with algebra is required. Statistical and probability concepts are developed as they are used. The term *introduction* merely describes the starting point. It is, therefore, reasonable to ask: Having entered the portal, how far can we go? By utilizing the additional materials that have been included in the Appendix, the course of instruction can be carried through the first level of graduate study at most institutions. The scope of the coverage is quite broad and arranged in such a way that the instructor, according to his own discretion, can design the course of study that is suitable for the circumstances.

It is with pleasure that I acknowledge the many sources (indicated throughout the book) which supplied materials for figures, tables, and in some cases, text. It was genuinely encouraging to observe the vigorous interest which individuals, industries, and institutions alike displayed in an effort to provide documents and information that would exactly match the requirements that had been posed. In particular, I want to express my appreciation to Gerald P. Brady, Professor of Business Law at the Graduate School of Business, Columbia University, for his counsel and help

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Susan Alexion deserves great credit for converting various forms of chaotic communications into a handsome final manuscript and for her ingenious utilization of the computer to help prepare the index. With perseverance and sagaciousness Don Levy has worked through and checked out text materials including the problems that follow each chapter. By so doing, he has substantially aided in the preparation of a detailed teachers' manual.

Polly Starr helped me in so many ways that only Elizabeth Barrett Browning could tell me how to count them.

MARTIN KENNETH STARR

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